

Sustainable Livelihood Index and Relative Importance of Regional Factors: A Study with Special Reference to Blocks of Undivided Midnapur District of West Bengal

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ABSTRACT

The concept of 'sustainable livelihoods' is an increasingly important word in today's agenda on the developmental debate about rural development. This paper describes the Sustainable Livelihoods Index (SLI) as a useful tool in assessing the livelihood elements of the three rural regions at the blocks level of Undivided Midnapur Districts of West Bengal. We use suitable unequal methodology like Fuzzy Set Analysis to calculate SLI consist of four groups of assets namely physical, cultural, social, and economic assets. The data sets for this study are census 2001, 2011 and different round of Districts Statistical hand books. The Sustainable Livelihood Index (SLI) significantly different among the blocks and three separate regions namely Jhargram, Paschim Midnapur and Purba Midnapur. The relative importance of factors in SLI has been assessed using the True Relative Importance methodology. This approach combines statistical logic, axioms, and theorems from various correlation measures, including squared orthopartial, semi-orthopartial, and simple correlations. Six factors were selected for analysis: student teacher ratio (STR), social factors like percentage of SC/ST people (PCSCST), cooperative attitude factors like ratio of member of cooperative and numbers of cooperatives (RCOPA), health related factors (BEDPINT) and percentage of indoor treatment out of total patients (POIND), economic factor like per capita small saving (PCSS) and time (TIME), to demonstrate how they contribute to sustainable livelihood. In the presence of multicollinearity, factors can exhibit positive or negative overlapping, depending on the absence or presence of enhancement synergism. The relatively most important factor is STR, while the least influential factor is POIND. STR appears as the most important factor because education directly strengthens skills, awareness, and opportunities, which strongly improve sustainable livelihood outcomes. Squared marginal correlations sometimes

overestimate or underestimate the true importance of variables because they do not separate unique effects from overlapping influences.

KEYWORDS: Fuzzy Set Analysis; Sustainable Livelihood Index; Orthopartial Correlation; Multicollinearity; True Relative Importance

1. INTRODUCTION

The sustainable livelihoods (SL) framework (Scoones, 1998, Carney, 1998) has been widely adopted by governments and donor agencies to improve the way rural peoples' lives are understood. It places people, particularly rural poor people, at the center of a web of inter-related influences that affect how these people create a livelihood for themselves and their households. The *livelihood assets* include natural resources, technologies, their skills, knowledge and capacity, their health, access to education, sources of credit, or their networks of social support. The extent of their access to these assets is strongly influenced by their *vulnerability context*, which takes account of trends (for example, economic, political, technological), shocks (for example, epidemics, natural disasters, civil strife) and seasonality (for example, prices, production, employment opportunities). Access to these assets is also influenced by the prevailing social, institutional and political environment, which affects the ways in which people combine and use their assets to achieve their goals. These are their livelihood strategies.

Livelihood is defined as “the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base” (Chambers and Conway, 1992). The livelihood framework theoretically describes employment activities and vulnerability management strategies (Pfluger, 2000).

The sustainable livelihood framework can be used as a qualitative analytical framework to identify and assess internal and external factors to the region and households that affect its socio-economic survival. It looks into livelihood strategies in a given vulnerable context. Livelihood strategies differ with regard to whether people have to deal with gradual changes or sudden shocks and crises.

As regards the livelihood strategy of the vulnerable section of the people, there are a numbers of deficiencies like low productivity, low income, high consumption share, no savings, lack of health and education, lower caste, gender inequality etc. However, what is really needed is an objective, to measure livelihood, calculated from a small number of specific dimensions of how assets-based capital impacts on people's livelihoods. While such a measure has yet to be agreed upon, it is hoped that study such as this will help to guide discussions toward a consensus on how such a measure may be derived.

This study is entirely based on the secondary data. The 54 blocks of Undivided Midnapur districts are purposely chosen for the present study. The data is based on Census 2001 and 2011 and districts statistical hand book of different year.

The Sustainable Livelihood Index (SLI) offers a composite framework to assess how multiple socio-economic and institutional factors interact to shape overall livelihood outcomes. Yet, identifying the relative importance of these factors is challenging, particularly when explanatory variables overlap through multicollinearity or synergistic effects. Traditional measures, such as simple or marginal correlations, often fail to provide an accurate decomposition of explanatory power, as they either overestimate or underestimate the true

contribution of a factor. As highlighted in empirical studies, reliance solely on marginal measures can lead to misleading conclusions when factors are interdependent or influenced by shared structural determinants.

To address this challenge, the True Relative Importance (TRI) methodology provides a statistically sound approach for evaluating the actual contribution of each factor by integrating squared orthopartial, semi-orthopartial, and simple correlations. This method corrects for overlaps, enhancement-synergism, and sign changes, yielding a clearer and more reliable decomposition of explanatory power. Applying this methodology allows a comprehensive assessment of how different dimensions, education, social structure, cooperativeness, economic stability, and health infrastructure, collectively shape sustainable livelihood outcomes.

Recent research on agricultural performance, factor importance, and modelling precision provides a strong methodological foundation for assessing regional determinants of sustainable livelihoods. Dolai et al. (2025) demonstrated that the True Relative Importance (TRI) method more accurately captures the contribution of agricultural factors, showing that irrigation and fertilizer use were the dominant drivers of India's agricultural growth from 1960–61 to 2019–20, while rainfall contributed minimally due to its uneven distribution; their work also highlights the limitations of relying on marginal correlations, which can misrepresent actual factor effects. Similarly, Dolai et al. (2023) found that across six agricultural sub-periods, irrigation, cropping intensity, and fertilizer use remained the most influential variables, reinforcing the centrality of controlled inputs over climate-dependent factors for regional development. Methodological improvements are further supported by Mondal et al. (2024), who showed that incorporating structural breaks significantly enhances the accuracy of time-series curve-fitting models for agricultural GDP, demonstrating that break-adjusted models outperform traditional approaches and better capture policy- and climate-induced fluctuations relevant to livelihood dynamics. Beyond production-related factors, Pradhan et al. (2023) revealed that India's economic openness exerts a greater influence on GDP growth than crude oil prices, and their introduction of the TRI approach effectively resolves multicollinearity issues inherent in the BAD method—an insight valuable for understanding macroeconomic contexts that shape livelihood opportunities. Complementing these studies, Dolai et al. (2025) applied fuzzy logic modelling to assess soil properties and found that pH and nutrient levels critically affect rice yield, with fuzzy models outperforming traditional predictive methods, thereby offering valuable tools for livelihood assessments in agrarian regions such as undivided Midnapur where soil variability influences household resilience.

Scope and Innovativeness of the Present Study

The scope of this research encompasses on the analysis of sustainable livelihood of the rural regions of undivided Midnapur and further to compare this status among the three considered districts of undivided Midnapur. For this purpose, we have constructed an index i.e., sustainability livelihood index (SLI). In this regard, Fuzzy methodology has been used. It is based on unequal weightage and have used the non-linear logarithm Fuzzy Membership Function to construct the aggregate index. Several researchers have considered the later methodology as appropriate to address the variability of the data. The analysis is important because these is wide regional variation in the un-divided Midnapur which can be unearthed using the Fuzzy Membership Function. This analysis can help and improve the block and districts level planning. Further, the effectiveness of the factors influencing it is also explored for achieving sustainability.

The present study offers a comprehensive and multidimensional assessment of the determinants of the Sustainable Livelihood Index (SLI) by examining six critical factors—Student–Teacher Ratio (STR), Percentage of SC/ST population (PCSCST), Cooperative Attitude (RCOPA), Beds per Institution (BEDPINT), Percentage of Indoor Treatment (POIND), Per Capita Small Savings (PCSS), and Time (TIME)—within a unified analytical framework. Its key innovation lies in the application of the True Relative Importance (TRI) methodology, which decomposes the explained variance into unique and overlapping components using squared orthopartial, semi-orthopartial, and simple correlations. Unlike conventional approaches that rely on marginal or simple correlations and often misrepresent contributions due to multicollinearity, the TRI method accounts for enhancement-synergism, sign changes, and variable overlaps, providing a more accurate and theoretically sound evaluation of each factor's true impact. By identifying which dimensions exert dominant, moderate, or minimal influence on livelihood sustainability, the study not only advances methodological rigor but also generates nuanced insights that can support evidence-based policy interventions aimed at strengthening sustainable livelihoods.

2. DATABASE AND METHODOLOGY

The database and methodology section provides a detailed roadmap of the analytical framework employed to dissect the impact of factors on Sustainable livelihood Index using unequal weights in case of 54 blocks of Undivided Midnapur in 2001 and 2011. Undivided Midnapur of West Bengal divided into three regional districts separated on January 1, 2002, it divided into Paschim Midnapur and Purba Midnapur and on April 2017 and further Paschim Midnapur divided into two parts Paschim Midnapur and Jhargram. Two secondary data sets, census and census amenities 2001 and 2011 and different round (2002-03, 2011-12, 2012-13) of districts statistical hand book are used for the study.

The methodology section is divided into various analytical stages, each employing specific econometric and statistical tools to analyze the data comprehensively. For the construction of the Sustainable Livelihood Index (SLI), four types of assets has been considered as dimensions and under that seven indicators have been taken. The dimensions and indicators are as follows: *Physical Assets (PHYASTI)*: Per capita land area, *Cultural Assets (CULTASTI)*: Percentage of total literacy and female literacy. *Social Assets (SOCASTI)*: sex ratio and worker population ratio, *Economic Asset*: Aman rice productivity and Percentage of main worker. The notation, specification and source of the indicators used for the construction of the SLI is given in Table 1.

Measures of Livelihood by using Fuzzy Analysis

Assume $i \in [1, n]$ respondent, $j \in [1, M]$ indicators related to livelihood. Consider $X^j = \left\{ X_{j/j=1,2,3,\dots,M} \right\}$ vectors of indicators respectively as capital assets. The variable X_j^i is the values taken by indicators j for the i -th respondent. For the formulation of Membership Function in respect of degree of effective achievement for each indicator, let us assume that μ_j^i provides the degree of effective achievement of the i -th respondent relative to the indicator j . When ranking values of j by increasing order (i.e., higher the value of a given indicator, higher is the degree of effective achievement), function μ_j^i is defined as follows:

$$\mu_j^i = \begin{cases} 1, & \text{If, } X_j^{max} \leq X_j^i \\ \frac{X_j^i - X_j^{min}}{X_j^{max} - X_j^{min}}, & \text{If, } X_j^{min} \leq X_j^i \leq X_j^{max} \\ 0 & \text{If, } X_j^i \leq X_j^{min} \end{cases}$$

Where, X_j^{min} and X_j^{max} are the lower and upper bound of the system. It is to be noted that the functions are increasingly linearly between zero and one according to the degree of effective achievement. If it is closer to one, it is an indication of high degree of achievements and if it is closer to zero, it is an indication of low degree of achievement.

The higher degree of achievement means higher level of livelihood. In order to obtain the composite index of 'livelihood' for each respondent block, different degrees of effective achievement are obtained for each respondent and indicator need to be summarized. Following Cerioli and Zani (1990), composite index is calculated by taking the weighted arithmetic mean of the membership functions, obtained from the respective indicators. Mathematically, it is represented as:

$$\mu_{LH}(i) = \sum_{j=1}^M W_j \mu_j \quad (i) \quad \dots\dots\dots (2)$$

Where W_j is the weight attributed to the respective indicators (j). The weight must be positive and its sum must be equal to one. That is

$$W_j \geq 0 \text{ and } \sum_{j=1}^M W_j = 1 \quad \dots\dots\dots (3)$$

The weights of each indicator are calculated as follows:

$$W_j = \log(1/\bar{\mu}_j) / \sum_{j=1}^M \log(1/\bar{\mu}_j) \quad \dots\dots\dots (4)$$

$$\text{Where, } \bar{\mu}_j = 1/N \sum_{j=1}^N \mu_j^i \quad \dots\dots\dots (5)$$

The weight W_j is the inverse function of the mean effective achievement level relative to the indicator j . Since livelihood does not vary in a linear way, the logarithmic curve function has been used into the weighting system. In this way a more important weight has been given to the indicators those are more widespread among the respondents. The composite index SLI with high numbers indicates favorable conditions. The high value of sustainable livelihood index indicates high level of livelihood while low value indicates low level of livelihood.

Notation Specification and their corresponding indicators, time period and data sources of the variable are given in the Table 1.

Table 1 Notation, Specification of the dimensions and indicators used in construction and analysis of Sustainable Livelihood Index

Notation	Specification	Source
Physical Asset Index (PHYASTI)	Per capita land area (in Hectare), 2003-04, 2011-12	DSH*
Cultural Asset Index (CULTASTI)	Percentage of Total Literacy rate, 2001,2011	Census
	Percentage of Female Literacy rate, 2001, 2011	Census
Social Asset Index (SOCASTI)	Sex ratio, 2001, 2011	Census
	Work Participation Rate, 2001, 2011	Census
Economical Asset Index (ECOACTI)	Aman Rice Productivity, 2003-04, 2012-13	DSH
	Percentage of Main Worker, 2001, 2011	Census

<i>Factors that Influence Sustainable Livelihood of the Region</i>		
Educational Factor (STR)	Student Teacher Ratio, 2003-04, 2012-13	DSH
Social Factor (PCSCST)	Percentage of SC/ST, 2001, 2011	Census
Cooperativeness Factor (RCOPA)	Ratio of Member of Cooperative and Number of Cooperative (Cooperative Attitude)	DSH
Health Factor (BEDPINT)	Bed per Institution, 2003-04,2012-13	DSH
Health Factor (POIND)	Percentage of Indore Treatment out of total Penitents, 2003-04,2012-13	DSH
Economical Factor (PCSS)	Per capital Small Saving,2003-04, 2012-13	DSH

Note: *DSH-District Statistical Hand Book.

Theoretical Background of Relative Importance

We use Ordinary Least Squares (OLS) specifications to analyse the data and estimate several critical measures, including marginal correlation, simple correlation, ortho correlation, and the relative relevance of the explanatory factors. Using these analytical tools, we may determine the magnitude and direction of connections between variables and acquire a better understanding of their relative importance in shaping the Livelihood Index. The following is our empirical specification:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + U$$

The Sustainable Livelihood Index (Y) is considered as the dependent variable, while several socio-economic and institutional factors are taken as independent variables to assess their influence on livelihood sustainability. These include: X_1 , the Social factor (PCSCST), representing the percentage of Scheduled Castes and Scheduled Tribes in 2001 and 2011; X_2 , the Health Factor (BEDPINT), indicating the number of beds per institution during 2003–04 and 2012–13; X_3 , another Health Factor (POIND), representing the percentage of indoor treatment out of total patients for the years 2003–04 and 2012–13; X_4 , the Economic Factor (PCSS), which denotes per capita small savings during 2003–04 and 2012–13; X_5 , the Educational Factor (STR), measured as the student–teacher ratio for the same years; and X_6 , the Cooperativeness Factor (RCOPA), defined as the ratio of cooperative members to the total number of cooperatives, reflecting the cooperative attitude within the community.

U is the random error term, and β_i is the coefficient of X_i , which represents the amount of change in Y for one unit change in X_i while keeping all other explanatory variables constant. This coefficient is also known as the partial regression coefficient.

The regression coefficient has two distinct interpretations, although the term partial regression coefficient applies to only one of them (see Mondal, 2008).

(i) It may represent the change in that specific portion of the dependent variable Y that is not influenced by the other independent variables, resulting from a one-unit change in the corresponding portion of X that is itself independent of the remaining predictors.

(ii) Alternatively, it may denote the change in Y that is attributable to a one-unit change in X , specifically in the component of X that cannot be explained by the other independent variables included in the model.

In the first type of regression, the resulting correlation is conventionally referred to as a partial correlation in the literature, although it does not reflect the true partial effect. The true partial

correlation arises only from the second regression. To resolve this inconsistency, Mondal (2008) introduced the term orthopartial correlation (with ortho signifying “correct”) to designate the correlation produced by the second regression, which accurately captures the true partial relationship.

The marginal explanatory power of an independent variable X_i can be expressed as:

$$\text{Marginal Explanatory Power}_{X_i}(r^2) = \frac{t^2_{X_i}}{t^2_{X_i} + \text{degree of freedom}}$$

where the degrees of freedom are defined as:

$$\text{degree of freedom} = n - (k + 1)$$

Here,

n = total number of observations,

k = number of independent variables in the model.

The partial or orthopartial explanatory power of an explanatory variable X_i may be expressed as follows:

$$\text{Partial / Orthopartial Explanatory Power}_{X_i}(r_i^2) = R_1^2(Y \text{ on } X_k) - R_2^2(Y \text{ on } X_{k-i}), \\ i = 1, 2, 3, \dots, k-1, k$$

Here,

$R^2(Y \text{ on } X_k)$ denotes the coefficient of determination after adding the explanatory variable whose orthopartial contribution is being evaluated, and

$R^2(Y \text{ on } X_{k-i})$ represents the coefficient of determination before the inclusion of that explanatory variable.

Mondal (2008) proposed that this measure is more appropriately termed orthopartial significance, because it reflects the true partial contribution of a variable after isolating the unique component of its explanatory power. This contrasts with conventional partial correlations, which are often influenced by multicollinearity and therefore do not yield a correct decomposition of explanatory effects.

The relative importance of an explanatory variable is obtained by combining its squared orthopartial correlation with a sequence of squared semi-orthopartial correlations, each weighted according to its contribution. Mondal (2008) addressed longstanding gaps in econometric theory by demonstrating a statistically valid method for decomposing the total R^2 into additive components attributable to each explanatory variable. Based on this formulation, five distinct theoretical cases arise, each requiring a specific approach to averaging orthopartial correlations:

Case I. No theoretical multicollinearity, no theoretical enhancement–synergism, and no theoretical change in sign.

Case II. Theoretical multicollinearity exists, but no enhancement–synergism and no change in sign.

Case III. Theoretical multicollinearity and enhancement–synergism exist, but no change in sign.

Case IV. Theoretical multicollinearity and a change in sign exist, but no enhancement–synergism.

Case V. Theoretical multicollinearity, enhancement–synergism, and change in sign all exist.

For a typical model with six explanatory variables— X_1, X_2, X_3, X_4, X_5 & X_6 — the schematic representation illustrates that these variables may be either partially or jointly interrelated. Such interdependence indicates the possible presence of multicollinearity, enhancement–synergism, or sign-reversal effects within the model. Consequently, the variance of Y explained by these six predictors is not mutually exclusive; rather, it consists of overlapping contributions arising from shared linear relationships among the variables. This overlap aligns with the structure of partial linear dependencies, typically represented schematically by intersecting regions, where each explanatory variable contributes both unique and common portions to the total explanatory power.

In a six-variable regression model, each explanatory factor produces 120 distinct paths $(6-1)!$ connecting its squared orthopartial correlation to its squared simple correlation. Along each path, six sequential points are generated: the first point represents the squared orthopartial correlation; the second point corresponds to the up-to-two-joint semi-orthopartial contribution; the third point reflects the up-to-three-joint contribution; the fourth point indicates the up-to-four-joint contribution; the fifth point represents the up-to-five-joint contribution; and the sixth point denotes the up-to-six-joint or simple explanatory power. Across these ordered contributions, three types of behavioural patterns may arise: change-in-sign (CS), no-change-in-sign (NCS), and enhancement–synergism (ES).

The relative importance of an explanatory variable can be evaluated in three forms: unsigned average, signed average, and adjusted signed average. Under the unsigned average, all joint contributions are taken in absolute terms, effectively assuming positive overlap among the variables. The signed average, by contrast, incorporates the usual pattern of positive and negative overlaps observed along the joint contributions. The adjusted signed average further refines this by correcting for sign-reversal behaviour: when a variable changes sign at any point, overlaps along all meaningful paths are adjusted accordingly (for example, if the signed average is negative, any positive joint contributions are treated as sign-change points, and vice versa). However, in the present case, such adjustment is unnecessary because the overall multiple regression explanatory power (R^2) and the aggregated contributions of all variables do not differ significantly in sign, eliminating the need for adjusted corrections.

The unsigned-average relative importance of the explanatory variable x_i is given by:

$$x_i = \left| \frac{\delta_1}{n} \right| + \left| \frac{\delta_{21} + \delta_{22} + \dots + \delta_{2(n-1)}}{n * (n-1)} \right| + \left| \frac{\delta_{31} + \delta_{32} + \dots + \delta_{3 \frac{(n-1)(n-2)}{2}}}{n * \frac{(n-1)(n-2)}{2}} \right| \\ + \left| \frac{\delta_{41} + \delta_{42} + \dots + \delta_{4 \frac{(n-1)(n-2)(n-3)}{3*2}}}{n * \frac{(n-1)(n-2)(n-3)}{3*2}} \right| + \dots \\ + \left| \frac{\delta_{k1} + \delta_{k2} + \dots + \delta_{kn-1c_{k-1}}}{n * n - 1c_{k-1}} \right| + \dots + \left| \frac{Simple}{n} \right|$$

Where,

n = total number of explanatory variables.

δ_1 = squared orthopartial contribution.

δ_{2j} = squared semi-orthopartial contribution for all “up-to-two-joint” combinations.

δ_{3j} = semi-orthopartial contributions for “up-to-three-joint” combinations.

δ_{kj} = semi-orthopartial contributions for “up-to-k-joint” combinations.

$(n - 1 \ k - 1)$ = number of possible joint-combination paths at level k .

“Simple” = squared simple correlation of X_i .

Absolute values ensure the unsigned nature of the measure (i.e., all overlaps assumed positive).

3. RESULTS AND DISCUSSIONS

Sustainable Livelihood Index in the Rural Undivided Midnapur

SLI for the studied in districts of undivided Midnapur is constructed on the basis of four assets as dimensions (Physical, Cultural, Social and Economic) with seven indicators (per capita land area, total literacy rate, female literacy rate, sex ratio, work participation rate, Aman rice productivity and percentage of non-marginal workers to total population). The SLI based on fuzzy measurement SLIFZ and is present in Table 2. The districts are considered the indices i.e., SLIFZ presents the scenario where Jhargram performed relatively better than Paschim Midnapur and Purba Midnapur. The values of SLIFZ of all the 54 blocks of undivided Midnapur are given in Table A1.

Table 2 Sustainable livelihood Index and its Rank based on measures Fuzzy index of Three Districts of Undivided Midnapur

Name	No. of Block	2011		2001	
		SLIFZ	Rank	SLIFZ	Rank
Regi Jhargram	8	0.606	1	0.526	1
on/D Paschim Midnapur	21	0.469	2	0.371	2
istic Purba Midnapur	25	0.318	3	0.314	3
t					
Undivided Midnapur	54	0.419	--	0.367	--

Sources: Authors' Calculation

It can be noted that Purba Midnapur is in a relatively better condition followed by Paschim Midnapur and Jhargram as regards to economic development of the society (Mandal 2021). But in the context of sustainable livelihood an opposite scenario is revealed where Jhargram performs relatively better followed by Paschim Midnapur and Purba Midnapur. The reason behind this variation can be unearthed if we consider the dimension-wise status of the districts. Table 3 presents the weighted dimensional index and their ranks based on Fuzzy Analysis. In respect of physical asset index, considering the three districts, Jhargram performed relatively better followed by Paschim Midnapur and Purba Midnapur. This was mainly due to high per capital land holding resulting in higher weight of physical assets as compared to other assets. The weight assigned to physical asset was 39.1 per cent while to cultural asset, social asset and economic asset are 14.1 per cent, 28.3 per cent and 18.5 per cent respectively as per analysis for all 54 blocks taken as Undivided Midnapur (Appendix Table A2). Based on cultural asset index, among the three districts, Purba Midnapur districts was comparatively in a better position followed by Paschim Midnapur and Jhargram Districts. This better performance of Purba Midnapur in the cultural asset index was mainly due to its better

performance in education. In case of social assets, this was mainly due to their higher sex ratio, Jhargram districts was comparatively in a better position followed by Paschim Medinipur and Purba Medinipur. In case of economical assets higher productivity of Aman rice and and higher percentage of non-marginal workers to total population as compared to other blocks. In 2001, all the three districts had the same position as in 2011 in case of physical, cultural and social asset. However, in case of economic asset the position of Paschim Medinipur and Purba Medinipur was interchanged.

Table 3 Dimensional Index and their Rank based on Fuzzy Analysis of the three Districts of Undivided Midnapur in 2011, 2001

		PHYA STI	Ra nk	CULA STI	Ran k	SOC ASTI	Rank	ECO ASTI	Ran k
2011									
Dis tric t	Jhargram Districts	0.289	1	0.031	3	0.177	1	0.109	2
	Paschim Midnapur	0.126	2	0.076	2	0.131	2	0.136	1
	Purba Midnapur	0.044	3	0.120	1	0.081	3	0.072	3
	Undivided Midnapur	0.112	–	0.090	–	0.115	–	0.102	–
2001									
Dis tric ts	Jhargram Districts	0.249	1	0.027	3	0.145	1	0.105	1
	Paschim Midnapur	0.107	2	0.064	2	0.108	2	0.091	3
	Purba Midnapur	0.036	3	0.105	1	0.073	3	0.099	2
	Undivided Midnapur	0.095	–	0.078	–	0.097	–	0.097	– o

Sources: Autor's' Calculation

Relative Importance of the factors

Although a wide range of factors can influence the Sustainable Livelihood Index, their relative importance in a multivariate framework can be difficult to determine, as many of these factors overlap and interact in both positive and negative ways. In this analysis, six factors, the Social Factor (PCSCST), Health Factors (BEDPINT and POIND), the Economic Factor (PCSS), the Educational Factor (STR), and the Cooperativeness Factor (RCOPA), collectively explain 41.6342% of the variation in the Livelihood Index. Among these, overlaps among the six factors account for 186 portions of explanatory power, indicating substantial shared influence that may operate either positively or negatively. Beyond these overlaps, only 6 portions of the total explanatory power arise from the factors acting independently or orthopartially.

From squared orthopartial to squared simple correlations, each factor generates 120 paths. A comparison between squared simple and squared orthopartial correlations shows that, for all variables except POIND, the squared simple correlations are higher than their corresponding orthopartial values. The presence of multicollinearity among the predictors, driven mainly by positive overlapping rather than any synergistic enhancement. As a result, squared simple correlations tend to overestimate the actual explanatory power of each factor.

In contrast, squared orthopartial correlations underestimate relative importance for all variables except POIND, which behaves inversely.

Table 4 Results from pooled regression of Sustainable livelihood Index on its factors

R Square	0.416342	Adjusted R Square		0.381669				
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>sq. marginal correla.</i>	<i>sq. simple correla.</i>	<i>sq. ortho correla.</i>	relative importance
Intercept	0.579666	0.033441	17.33389	4.95E-32				
STR	-0.00265	0.000602	-4.40495	2.64E-05	0.161154	0.2764	0.11213	0.178382
PCSCST	0.001036	0.00039	2.657895	0.009143	0.065372	0.118175	0.040824	0.07043
RCOPA	-0.00015	4.56E-05	-3.30815	0.001302	0.097762	0.12194	0.06324	0.084103
BEDPINT	-4.5E-05	0.000765	-0.05944	0.952718	3.5E-05	0.088932	2E-05	0.031719
POIND	-0.00118	0.00153	-0.77266	0.441526	0.005876	0.000505	0.00345	0.001691
PCSS	-0.03288	0.01893	-1.73697	0.085441	0.029006	0.10223	0.01744	0.050016
Total					0.359205	0.708183	0.2371	0.416342

The assessment of relative importance using squared marginal, simple, and orthopartial correlations reveals meaningful insights into how different socio-economic and institutional factors shape livelihood sustainability. Among the six variables, the Student–Teacher Ratio (STR) stands out as the most influential determinant, with the highest relative importance value of 0.178. This strong contribution reflects the crucial role of educational infrastructure in strengthening human capital. A favourable STR enhances the quality of education, improves learning outcomes, and broadens skill development, all of which translate into better employment opportunities, higher productivity, and greater adaptive capacity in rural and semi-urban settings. As education strongly influences multiple dimensions of livelihood, its dominant statistical weight corresponds well with its real-world impact.

Following STR, the Cooperative Attitude (RCOPA) and the Percentage of SC/ST population (PCSCST) exhibit moderate yet meaningful importance, with relative contributions of 0.084 and 0.070. RCOPA's influence highlights the value of community cooperation, mutual support systems, and collective economic activities in improving livelihood conditions. Cooperative institutions often enable shared access to credit, inputs, and information, making communities more resilient and economically stable. Meanwhile, PCSCST reflects the socio-

demographic composition of the region. Areas with higher SC/ST populations often face structural disadvantages, limited access to resources, and socio-economic vulnerabilities, making this factor moderately influential in explaining variations in livelihood sustainability.

Per capita small savings (PCSS), with a relative importance of 0.050, also shows moderate significance. Savings represent financial security, economic stability, and the ability to cope with shocks. Households with higher savings capacity tend to have better resilience against livelihood risks, improved investment potential, and more stable income patterns. Therefore, its moderate explanatory power aligns with its practical role in enhancing economic well-being.

In contrast, the health-related variables, Beds per Institution (BEDPINT) and Percentage of Indoor Treatment (POIND), account for relatively minor portions of the explanatory power, with values of 0.031 and 0.001, respectively. Although health is a fundamental component of human development, these particular indicators capture narrow and specific dimensions of the health system. BEDPINT reflects health infrastructure availability but does not necessarily indicate utilization, accessibility, or quality of care. POIND, representing indoor treatment rates, captures only inpatient services and often fails to reflect overall population health, especially in regions where outpatient care or informal treatment is more common. Furthermore, both variables share considerable overlap with other factors and exhibit weaker independent effects, thereby reducing their relative importance in the multivariate framework.

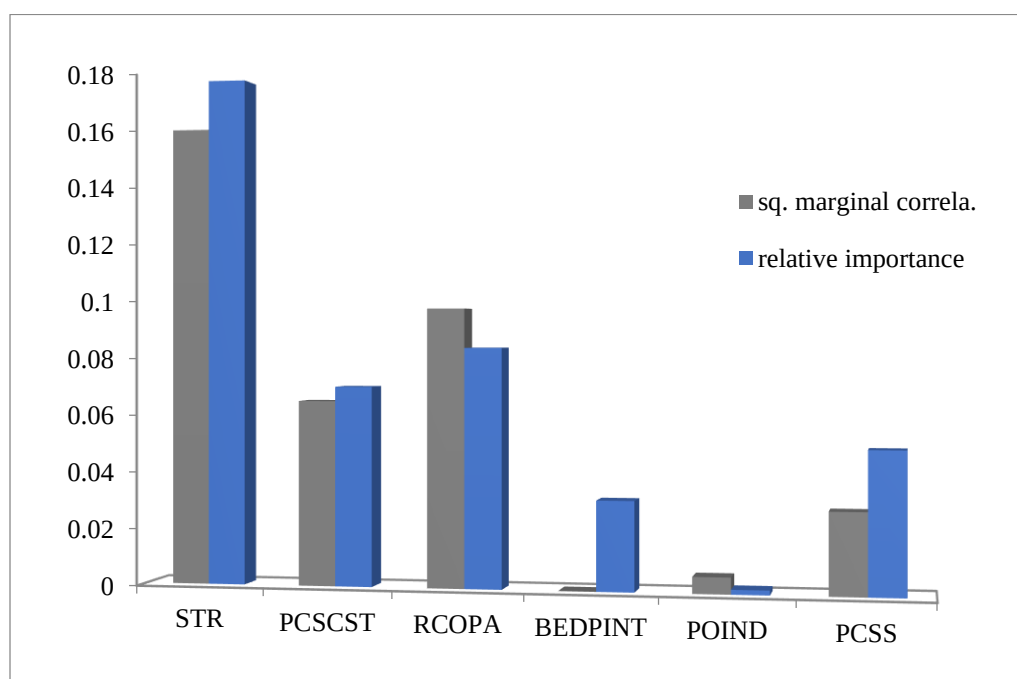


Figure-1: Comparison of Squared Marginal Correlations and True Relative Importance

When squared marginal correlations are used to measure each factor's explanatory power, they sometimes overestimate or underestimate the true importance of the variables because they do not separate unique effects from overlapping influences. In this case, the marginal correlations underestimate the real importance of STR, PCSCST, BEDPINT, and PCSS, while they overestimate the importance of RCOPA and POIND.

4. CONCLUSION

To construct a suitable composite Sustainable Livelihood Index, we have used unequal weight methodology popularly Fuzzy methodology to address that the variability for the construction of sustainable livelihood index. Since, there is wide regional variation in the undivided Midnapur. Considering three regions or districts of Undivided districts, the Purba Midnapur is in a relatively better condition followed by Paschim Midnapur and Jhargram as regards to economic development of the society (Mandal 2021). But in the context of sustainable livelihood an opposite scenario is revealed where Jhargram performs relatively better followed by Paschim Midnapur and Purba Midnapur.

The relative importance of factors influencing the Sustainable Livelihood Index (SLI) has been evaluated using the True Relative Importance methodology, which integrates statistical logic, axioms, and theorems derived from squared orthopartial, semi-orthopartial, and simple correlations. Six key factors, Student–Teacher Ratio (STR), social composition (PCSCST), cooperative attitude (RCOPA), health-related indicators (BEDPINT and POIND), economic security through per capita small savings (PCSS), and time (TIME)—were analyzed to understand their contributions to sustainable livelihoods. In the presence of multicollinearity, these factors display both positive and negative overlaps, shaped by the presence or absence of enhancement synergism. The analysis identifies STR as the most influential factor and POIND as the least impactful. STR emerges as the strongest driver because education enhances skills, awareness, and opportunities, thereby improving livelihood outcomes. Additionally, squared marginal correlations may either overestimate or underestimate true factor importance, as they do not distinguish unique contributions from overlapping effects.

6. BIBLIOGRAPHY

- Alkire, S. and J.E. Foster (2011), Counting and Multidimensional Poverty Measurement, *Journal of Public Economics*, 95(7–): 476–487.
- Carney D (ed.) (1998) Sustainable Rural Livelihoods: What Contribution Can We Make?. Department for International Development, London.
- Chambers, R. and Conway, G. (1992), Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. IDS Discussion Paper 296. Brighton: IDS.
- Mandal, J. (2021), Social Protection and Multidimensional Poverty: A Study with Special Reference Backward Districts West Bengal, PhD thesis, Vidyasagar University
- Mcleod R. (2001a), The impact of regulations and procedures on the livelihoods and asset base of the urban poor: a financial perspective. Paper presented at the International Workshop on Regulatory Guidelines for Urban Upgrading, Bourton-on-Dunsmore, May 17-18, 2001.
- Scoones I (1998), Sustainable Rural Livelihoods: A Framework for Analysis. IDS Working Paper No. 72, Institute of Development Studies, University of Sussex, UK.
- Dolai, R., & Mondal, D. (2023). Agricultural growth in India: A comparative analysis of sub-periods from 1960-61 to 2019-20. *Journal Press India*, 10(2). <https://doi.org/10.17492/jpi.pragati.v10i2.1022301>
- Mondal, D., & Dolai, R. (2024). Necessity of incorporating break-in-trend in aggregate time series data: evidence from agricultural GDP in India. *PRAGATI: Journal of Indian Economy*, 11(2), 27-38. <https://doi.org/10.17492/jpi.pragati.v11i2.1122402>
- Dolai, R. K., & Mondal, D. (2025). Relative importance of agricultural factors on India's GDP growth. *Farming & Management*, 10(1), 65-74. <https://doi.org/10.31830/2456-8724.2025.FM-158>
- Dolai, R. K., & Das, P. (2025). Analysing Rice Productivity in India using a Fuzzy Logic Model based on Soil Quality Parameters. *Spectrum of Engineering and Management Sciences*, 1-14.

- Dolai, Rajib Kumar, (2025). Growth Break and Fluctuation in Indian Agriculture An analysis for the Period 1960 61 to 2019 20, *Vidyasagar University*, <http://hdl.handle.net/10603/647182>
- Mondal, D. (2008). On the Test of Significance of Linear Multiple Regression Coefficients. *Communications in Statistics - Simulation and Computation*, 37(4), 713–730. <https://doi.org/10.1080/03610910701753853>
- Pradhan. D, Mondal. D (2023). Relative Importance of Openness Index and Crude Oil Price in Explaining Growth of India's GDP During 1970-71 to 2019-20, *International Journal of Innovative Research in Engineering and Management (IJIREM)*, 10(6). 60-65, DOI: <https://doi.org/10.55524/ijirem.2023.10.6.9>

Appendix Table

Table A1 Block wise Component Index of Sustainable Livelihood Index based on Fuzzy Analysis and Aggregate Index and Rank of both Measures Fuzzy (SLIFZ) and Dimensional Index (SLIDI) in 2011

Sub-Division	Blocks/Districts	PHYA STI	Ra nk	CULA STI	Ra nk	SOCA STI	Ra nk	EOCA STI	Ra nk	SLI FZ	Ra nk
Jhargram	Jhargram	0.33	3	0.04	47	0.19	6	0.12	25	0.67	5
	Binpur-I	0.23	9	0.03	52	0.18	8	0.11	27	0.55	8
	Binpur-II	0.39	1	0.03	51	0.22	2	0.07	42	0.72	2
	Jamboni	0.30	5	0.04	48	0.15	14	0.08	36	0.58	7
	Nayagram	0.39	2	0.00	54	0.23	1	0.12	23	0.73	1
	Sankrail	0.24	8	0.05	44	0.19	5	0.13	16	0.62	6
	Gopiballav pur-I	0.26	7	0.01	53	0.11	22	0.12	20	0.51	12
	Gopiballav pur-II	0.17	12	0.04	49	0.14	16	0.13	18	0.47	17
	Jhargram	0.29	1	0.03	8	0.18	1	0.11	4	0.61	
Sadar	Salboni	0.31	4	0.06	42	0.19	4	0.15	7	0.71	3
	Keshpur	0.12	18	0.07	36	0.10	30	0.14	10	0.43	22
	Garbeta-I	0.14	15	0.05	46	0.11	23	0.15	3	0.45	19
	Garbeta-II	0.28	6	0.06	41	0.18	10	0.16	1	0.68	4
	Garbeta-III	0.17	11	0.05	43	0.15	13	0.15	6	0.53	9
	Medinipur	0.15	13	0.04	50	0.14	17	0.15	4	0.47	16
	Sadar	0.20	2	0.06	7	0.14	2	0.15	1	0.55	
Kharagpur	Debra	0.09	24	0.09	31	0.20	3	0.15	5	0.53	10
	Pingla	0.09	26	0.10	27	0.15	15	0.14	15	0.47	18
	Keshiary	0.19	10	0.07	39	0.17	11	0.10	31	0.52	11
	Dantan-I	0.13	16	0.05	45	0.11	24	0.12	21	0.40	25
	Dantan-II	0.09	23	0.10	30	0.07	45	0.12	19	0.38	31
	Narayangar h	0.15	14	0.07	35	0.17	12	0.11	28	0.50	13
	Mohanpur	0.09	20	0.09	33	0.05	52	0.14	8	0.37	32
	Sabong	0.08	27	0.12	13	0.18	7	0.12	24	0.50	14
	Kharagpur-I	0.09	22	0.07	38	0.12	21	0.16	2	0.44	20
	Kharagpur-II	0.12	17	0.06	40	0.18	9	0.11	26	0.48	15
	Khargrapur	0.11	3	0.08	6	0.14	3	0.13	3	0.46	
Ghatal	Chandrakona-I	0.12	19	0.08	34	0.09	36	0.14	11	0.43	23

	Chandrakon a-II	0.09	21	0.07	37	0.09	34	0.14	14	0.39	29
	Ghatal	0.06	34	0.09	32	0.07	47	0.14	9	0.36	35
	Daspur-I	0.04	43	0.10	26	0.13	18	0.14	13	0.42	24
	Daspur-II	0.03	47	0.11	24	0.11	26	0.14	12	0.38	30
	Ghatal	0.07	4	0.09	5	0.10	5	0.14	2	0.39	
	Paschim Midnapur	0.13	2	0.08	2	0.13	2	0.14	1	0.47	
Tamluk	Tamluk	0.01	52	0.12	11	0.09	35	0.09	34	0.30	45
	Sahid Matangini	0.00	54	0.12	12	0.05	53	0.08	39	0.24	51
	Panskura-I	0.05	40	0.10	28	0.13	20	0.08	37	0.36	36
	Kolaghat	0.00	53	0.11	25	0.07	46	0.09	32	0.27	49
	Moyna	0.02	48	0.12	16	0.03	54	0.05	49	0.23	54
	Nandakumar	0.02	51	0.11	20	0.08	38	0.07	41	0.28	48
	Chandipur	0.03	45	0.13	8	0.06	49	0.02	54	0.24	52
	Tamluk	0.02	8	0.12	3	0.07	8	0.07	6	0.27	
Haldia	Mahishadal	0.03	46	0.12	15	0.08	41	0.07	45	0.29	47
	Nandigram-I	0.05	39	0.11	22	0.08	42	0.06	47	0.30	46
	Nandigram-II	0.05	41	0.13	3	0.10	28	0.06	48	0.34	38
	Sutahata	0.02	50	0.11	21	0.05	51	0.05	52	0.23	53
	Haldia	0.02	49	0.12	17	0.07	43	0.06	46	0.27	50
	Haldia	0.03	7	0.12	2	0.08	7	0.06	8	0.28	
Egra	Potashpur-I	0.06	32	0.11	19	0.11	25	0.11	29	0.39	27
	Potashpur-II	0.08	28	0.12	14	0.08	40	0.10	30	0.37	33
	Bhagawanpur-I	0.03	44	0.13	9	0.10	29	0.05	51	0.31	44
	Egra-I	0.09	25	0.10	29	0.13	19	0.12	22	0.43	21
	Egra-II	0.07	30	0.12	18	0.08	37	0.13	17	0.40	26
	Egra	0.07	4	0.11	4	0.10	5	0.10	4	0.38	
Contai	Khejuri-I	0.06	35	0.13	4	0.08	39	0.05	50	0.33	41
	Khejuri-II	0.06	33	0.11	23	0.06	48	0.07	43	0.31	43
	Bhagawanpur-II	0.06	37	0.14	1	0.10	27	0.03	53	0.33	40
	Ramnagar-I	0.04	42	0.12	10	0.09	33	0.09	35	0.34	37
	Ramnagar-II	0.07	29	0.13	6	0.10	32	0.07	40	0.37	34
	Contai-I	0.05	38	0.13	5	0.07	44	0.08	38	0.34	39
	Deshapran	0.06	36	0.13	7	0.06	50	0.07	44	0.31	42
	Contai-III	0.07	31	0.14	2	0.10	31	0.09	33	0.39	28
	Contai	0.06	6	0.13	1	0.08	7	0.07	7	0.34	
	Purba Midnapur	0.04	3	0.12	1	0.08	3	0.07	2	0.32	

Table A2 Dimensional Index and weight for Construction of SLIFZ in Jhargram, Paschim Midnapur and Purba Midnapur Districts of Undivided Midnapur, 2011

	Blocks	PHYA STI	Wei ght	CULA STI	Wei ght	SOCA STI	Wei ght	ECOA STI	Wei ght	SLI FZ	Ra nk
	Jhargram	0.83	0.39	0.31	0.14	0.66	0.28	0.62	0.19	0.67	5

Jhargra m	Binpur-I	0.59	0.39	0.21	0.14	0.65	0.28	0.60	0.19	0.55	8
	Binpur-II	1.00	0.39	0.23	0.14	0.79	0.28	0.37	0.19	0.72	2
	Jamboni	0.76	0.39	0.31	0.14	0.54	0.28	0.44	0.19	0.58	7
	Nayagram	0.99	0.39	0.00	0.14	0.80	0.28	0.63	0.19	0.73	1
	Sankrail	0.62	0.39	0.36	0.14	0.68	0.28	0.72	0.19	0.62	6
	Gopiballa vpur-I	0.67	0.39	0.06	0.14	0.40	0.28	0.67	0.19	0.51	12
	Gopiballa vpur-II	0.44	0.39	0.27	0.14	0.48	0.28	0.68	0.19	0.47	17
Sadar	Salboni	0.80	0.39	0.41	0.14	0.68	0.28	0.78	0.19	0.71	3
	Keshpur	0.31	0.39	0.52	0.14	0.34	0.28	0.77	0.19	0.43	22
	Garbeta-I	0.36	0.39	0.34	0.14	0.39	0.28	0.83	0.19	0.45	19
	Garbeta-II	0.70	0.39	0.44	0.14	0.63	0.28	0.88	0.19	0.68	4
	Garbeta- III	0.44	0.39	0.38	0.14	0.54	0.28	0.79	0.19	0.53	9
	Medinipur	0.39	0.39	0.26	0.14	0.48	0.28	0.80	0.19	0.47	16
Kharag pur	Debra	0.23	0.39	0.67	0.14	0.69	0.28	0.80	0.19	0.53	10
	Pingla	0.22	0.39	0.72	0.14	0.51	0.28	0.73	0.19	0.47	18
	Keshiary	0.48	0.39	0.48	0.14	0.61	0.28	0.51	0.19	0.52	11
	Dantan-I	0.33	0.39	0.36	0.14	0.39	0.28	0.63	0.19	0.40	25
	Dantan-II	0.23	0.39	0.68	0.14	0.24	0.28	0.67	0.19	0.38	31
	Narayang arh	0.38	0.39	0.52	0.14	0.61	0.28	0.58	0.19	0.50	13
	Mohanpur	0.24	0.39	0.61	0.14	0.17	0.28	0.78	0.19	0.37	32
	Sabong	0.21	0.39	0.83	0.14	0.65	0.28	0.62	0.19	0.50	14
	Kharagpur -I	0.24	0.39	0.49	0.14	0.44	0.28	0.84	0.19	0.44	20
	Kharagpur -II	0.31	0.39	0.45	0.14	0.64	0.28	0.62	0.19	0.48	15
Ghatal	Chandrak ona-I	0.31	0.39	0.57	0.14	0.30	0.28	0.76	0.19	0.42	23
	Chandrak ona-II	0.24	0.39	0.50	0.14	0.31	0.28	0.74	0.19	0.39	29
	Ghatal	0.16	0.39	0.62	0.14	0.23	0.28	0.78	0.19	0.36	35
	Daspur-I	0.11	0.39	0.73	0.14	0.47	0.28	0.75	0.19	0.42	24
	Daspur-II	0.07	0.39	0.80	0.14	0.37	0.28	0.75	0.19	0.38	30
Tamlu k	Tamluk	0.02	0.39	0.85	0.14	0.30	0.28	0.48	0.19	0.30	45
	Sahid Matangini	0.00	0.39	0.84	0.14	0.16	0.28	0.42	0.19	0.24	51
	Panskura- I	0.12	0.39	0.72	0.14	0.44	0.28	0.44	0.19	0.36	36
	Kolaghat	0.01	0.39	0.77	0.14	0.24	0.28	0.50	0.19	0.27	49
	Moyna	0.06	0.39	0.82	0.14	0.12	0.28	0.29	0.19	0.23	54
	Nandaku mar	0.05	0.39	0.81	0.14	0.29	0.28	0.38	0.19	0.28	48
	Chandipur	0.08	0.39	0.89	0.14	0.22	0.28	0.10	0.19	0.24	52
Haldia	Mahishad al	0.07	0.39	0.83	0.14	0.27	0.28	0.35	0.19	0.29	47
	Nandigra m-I	0.13	0.39	0.80	0.14	0.27	0.28	0.31	0.19	0.30	46
	Nandigra m-II	0.12	0.39	0.95	0.14	0.36	0.28	0.30	0.19	0.34	38
	Sutahata	0.05	0.39	0.80	0.14	0.18	0.28	0.24	0.19	0.23	53
	Haldia	0.06	0.39	0.82	0.14	0.25	0.28	0.33	0.19	0.27	50

Egra	Potashpur-I	0.16	0.39	0.81	0.14	0.38	0.28	0.57	0.19	0.39	27
	Potashpur-II	0.20	0.39	0.83	0.14	0.28	0.28	0.52	0.19	0.37	33
	Bhagawanpur-I	0.08	0.39	0.89	0.14	0.35	0.28	0.26	0.19	0.31	44
	Egra-I	0.23	0.39	0.69	0.14	0.47	0.28	0.63	0.19	0.43	21
	Egra-II	0.18	0.39	0.81	0.14	0.30	0.28	0.70	0.19	0.40	26
Contai	Khejuri-I	0.16	0.39	0.93	0.14	0.28	0.28	0.28	0.19	0.33	41
	Khejuri-II	0.16	0.39	0.80	0.14	0.22	0.28	0.36	0.19	0.31	43
	Bhagawanpur-II	0.15	0.39	1.00	0.14	0.36	0.28	0.14	0.19	0.33	40
	Ramnagar-I	0.11	0.39	0.87	0.14	0.32	0.28	0.46	0.19	0.34	37
	Ramnagar-II	0.18	0.39	0.93	0.14	0.33	0.28	0.39	0.19	0.37	34
	Contai-I	0.14	0.39	0.93	0.14	0.24	0.28	0.44	0.19	0.34	39
	Deshapran	0.16	0.39	0.90	0.14	0.21	0.28	0.36	0.19	0.31	42
	Contai-III	0.17	0.39	0.96	0.14	0.34	0.28	0.49	0.19	0.39	28
	Un Divided Midnapur	0.29	0.39	0.64	0.14	0.41	0.28	0.55	0.19	0.42	
	Percentage of Weight	--	39.1	--	14.1	--	28.3	--	18.5	100	--